What is claimed is:

1. A fuel vapor pressure management apparatus of a fuel system supplying fuel to an internal combustion engine, the fuel vapor pressure management apparatus performing leak detection on a headspace of the fuel system, the apparatus comprising:

a housing defining an interior chamber;

a pressure operable device separating the interior chamber into first and second portions, the pressure operable device including a seal and a poppet cooperatively engaging the seal with a contact force, the seal includes a first effective area equal to a difference between a first area defined by a major perimeter and a second area defined by a minor perimeter, and the poppet is movable along an axis and includes a second effective area defined by the minor perimeter of the seal; and

a switch positioned in the second portion of the interior chamber, the switch requiring an activation force to actuate the switch;

wherein a first pressure level at which excess negative pressure is relieved is calculated by dividing the contact force by the first effective area, and a second pressure level at which excess positive pressure is relieved is calculated by dividing the activation force by the second effective area.

2. The apparatus according to claim 1, wherein an activation vacuum in the second portion of the interior chamber creates a poppet force displacing the poppet toward the switch, the poppet force is calculated by multiplying the second effective area by the activation vacuum.

3. The apparatus according to claim 2, wherein the seal comprises a lip that projects at an oblique angle relative to the axis, is deflected an axial distance by engagement of the poppet with the seal, and includes a modulus of elasticity, a thickness, a durometer hardness, and a friction coefficient, and a lip seal force is a function of at least the thickness, the oblique angle, the axial distance, the modulus of elasticity, the durometer hardness, and the friction coefficient.

4. The apparatus according to claim 3, further comprising:

a resilient element positioned in the first portion of the interior chamber and biasing the poppet toward the seal, a biasing force of the resilient element is calculated by subtracting the poppet force from the activation force and adding the difference between the lip seal force and a lip vacuum force.

5. The apparatus according to claim 3, wherein a vacuum in the second portion of the interior chamber during the leak detection decreases in response to an increase in the minor perimeter, increases in response to an increase in at least one of the thickness, durometer hardness, friction coefficient, oblique angle, and axial distance, and is unchanged in response to an increase in the major perimeter.

6. The apparatus according to claim 3, wherein the first pressure level increases in response to an increase in at least one of the minor perimeter, the thickness, the durometer hardness, the friction coefficient, and the axial distance, and decreases in response to an increase in at least one of the major perimeter and the oblique angle.

7. The apparatus according to claim 3, wherein the second pressure level decreases in response to an increase in the minor perimeter, increases in response to an increase in at least one of the thickness, the durometer hardness, the friction coefficient, and the axial distance, and is unchanged in response to an increase in at least one of the major perimeter and the oblique angle.

8. The apparatus according to claim 1, wherein the major perimeter comprises a first circle having a first diameter, the minor perimeter comprises a second circle having a second diameter, and the first diameter is greater than the second diameter.

9. The apparatus according to claim 1, wherein the excess negative and excess positive pressures to be relieved occur in the second portion.

10. A method of designing fuel vapor pressure management apparatus of a fuel system supplying fuel to an internal combustion engine, the fuel vapor pressure management apparatus including a housing, a pressure operable device including a seal cooperatively engaging a poppet, and a switch, the method comprising:

selecting the seal so as to include a major perimeter defining a first area and to include a minor perimeter defining a second area, the seal including a first effective area equal to a difference between the first area and the second area;

selecting the poppet so as to include a second effective area defined by the minor perimeter of the seal;

selecting a contact force when the seal cooperatively engages the poppet;

selecting the switch so as to require an activation force to actuate the switch;

calculating a first pressure level at which excess negative pressure is relieved, the calculating the first pressure level including dividing the contact force by the first effective area; and

calculating a second pressure level at which excess positive pressure is relieved, the calculating the second pressure level including dividing the activation force by the second effective area.

11. The method according to claim 10, further comprising:

performing the leak detection at a third pressure level between the first and second pressure levels.

12. The method according to claim 11, wherein the third level comprises a vacuum relative to ambient pressure.